

No. 146

**The Effects of Science Education on
National Economic Growth in
The World and Singapore**

Ng Tang Nah

Department of Sociology
National University of Singapore
11 Arts link
Singapore 117570

Fax: 777-9579

e-mail: socngtn.nus.edu.sg

ISSN0129-8186
ISBN 981-3033-40-1
All rights reserved 1999

The *Working Papers Series* is edited by a committee comprising **Maribeth Erb, Angelique Chan and Vineeta Sinha**. This series was established by the Department of Sociology, National University of Singapore in 1973, as a forum for staff members, graduate students and visitors to the department to circulate their work in progress. Please refer to the back for a list of all past working papers.

All orders may be directed to:

Select Books

19 Tanglin Road, #03-15
Tanglin Shopping Centre
Singapore 247909
Tel: 65 732 1515
Fax: 65 736 0855
e-mail: selectbk@cyberway.com.sg

The Effects of Science Education on National Economic Growth in The World and Singapore

Ng Tang Nah

INTRODUCTION

The effects of education on economic growth have been shown to vary by multifarious factors, such as (1) country, (2) level of schooling (mass, secondary, tertiary), (3) type of schooling (emphasis on math and science curricula or not), (4) central national control, (5) student participation, (6) tight or loose rules of allocation to the labor market, (7) quality of schooling, (8) economic structural needs, (9) global economic conditions and (10) global trends in citizenship conceptions (Rubinson and Browne, 1994; Rubinson, 1986; Walters and Rubinson, 1983; Benavot, 1992; Meyer et. al., 1991). Prior research has shown that these features often interact to affect the relation between education and economic growth. In general, answers are sought by looking at the benefits of education to individuals and collectives.

Studies of the United States and Singapore have shown that individuals realize a positive economic return from years of schooling, even controlling for a large number of factors (Denison, 1962, 1967; Blau and Duncan, 1967; Sewell and Hauser, 1975; Low et. al.; Teo, 1988). It is still possible that a positive relationship exist between years of schooling and earnings for individuals even if there is no positive relation between educational expansion and economic growth for the country as a whole. At the individual level, positive returns to schooling can be explained by the schooling's effect on the process by which income is distributed among individuals within a given economic structure. At the macro level, the positive return to schooling for the economy as a whole can be explained by the effect of an aggregate educational expansion on the occupational and economic structure. An overall increase in educational credentials may simply increase competition for access to similar jobs across time rather than contribute to a change in the economic structure (Walters and Rubinson, 1984). Most research has adopted the marginal productivity theory and used the process at the individual level to estimate the process at the aggregate level. An important problem is that there are ways in which schooling or educational institutions affect the economy that do not work through individuals. The contribution of research and development generated in educational institution to economic development is an example. The education system may also maintain the social and political framework necessary for increased economic growth (for example, through the education of multiracial values for

maintaining social harmony). Hence, to capture the possible, direct effects of education on the economy, one needs to look not only at the aggregation of individual-level educational effects, but also at the level of the economy as a whole. This is usually accomplished by looking at the factors of the production function and national economic growth rates. In this paper, I review theories and research findings that are based on cases in the developed and developing countries of the world. In addition, the rest of the paper discusses the historical evolution and development of Singapore's education system, and conducts preliminary analysis of the relation between education and the economy as a whole.

1. Theories

1.1 Technical-Functional

Traditionally, what an education system should look like to maximize economic growth was examined by looking at the relation between schooling and the occupational structure among individuals, assuming aggregation effects of individuals for collectives but neglecting effects on the collective in different contexts. The technical-functional (focusing on individual effects) or modernization (on national societal effects) theories are theories of the organization of socialization and production processes. Education as formal bureaucratic organization provides the necessary socialization to modern attitudes and to acquire required job skills (human capital theory). Education inculcates modern values and behavior of diligence, achievement, meritocracy and rational accounting, so as to set the stage for modernization and economic development. Education on job-relevant skills is assumed to lead to increased marginal productivity (represented by wages, ideally), and aggregate production. Hence, the cumulative effects of the stock of modern values, orientations and skills are expected to cause an increase in societal level economic output.

The ideal education structure which could maximize economic growth comprises of at least 5 characteristics (Rubinson and Fuller, 1991):

- 1) There are exactly the right number of students enrolled at each level to meet labor market requirements (supply of schooling process).
- 2) Students actually learn what's taught and there is high uniformity in learning (quality)
- 3) Curriculum content is relevant only to economic requirements.
- 4) Exact allocation of bodies to jobs by industrial policy and its periodization.
- 5) Feedback mechanisms (market or bureaucracy) which tell schools what the needs of the economy are.

Most education systems however, do not look like this. Class reproduction and status conflict theories argue that, to the extent that schooling is organized to reproduce the class structure and the expansion of schooling reflects status competition, education systems cannot be as ideal. These processes result in restriction of enrollments, divisive curricula content and non-market based allocation to jobs. Empirical research of macro-economists (Denison, 1962, 1967, Jorgenson, 1984, Lundgreen, 1976) have produced fairly supportive evidence that the changes in the quality of labor contributed by education, controlling for increased labor and capital inputs, favorably impact aggregate productivity. But these analyses suffer from the aggregation fallacy (Meyer and Hannan, 1979) and neglect allocation processes based on status competition (ethnic, race and gender) and class reproduction (Collins, 1979; Thurow, 1974; Bowles and Gintis, 1976; Pscharopoulos, 1981; England, 1992; Bourdieu and Passeron, 1977; Lareau, 1990).

1.2 Allocation

One strand of allocation theories is status competition theory, which posits that status competition for occupational advantage results in restricted access to occupations based on different status group membership. The main activity in schools then becomes the teaching and certification of students in particular values, tastes, vocabulary and sociability, not technical skills. As members in one group acquire more education to have access to higher-status, higher-wage jobs, other members in the next level follow suit to maintain their status advantage. Credentialism, not associated with increased job skills or productivity, follows. Curricula division along cultural capital, instead of economically-relevant skills, is often associated with credentialism in mass systems (e.g. the U.S.) with relatively unlimited supply of schooling (Collins, 1974). The feedback mechanism is thus impaired by the market mechanism itself. Moreover, the feedback mechanism made possible by a more central state control system can also be impaired by credentialing, as the recruitment of bureaucrats suffer from the same phenomenon. Bureaucrats have to insulate political decision-making from class interests and its own interests (economically or status induced), which is difficult.

The other variant of allocation theory, class reproduction, sees education expansion as driven by the coercive demands of capitalism, not the demands of job skills and labor productivity. School expansion has no necessary connection to technology, skills, labor productivity or economic growth. Any effect of education on economic growth should be indirect, as education serves to increase the political legitimation of capitalist authority relations within work organizations and within the state itself. Education is a means to enforce capitalist authority, discipline the working class, and create proper work attitudes for the different classes.

Allocation theories assume that education has no necessary effect on economic growth through increasing the labor productivity of individuals. For class reproduction theory, the empirical evidence focuses on the legitimation effect (e.g. Bourdieu and Passeron, 1977, Lareau, 1990), and often only the effects of education on individuals (e.g. cultural capital, student-peer resistance studies, ideology and curriculum). The research often fallaciously assumes that the aggregate national effect is similar. For status competition theory, the relevant empirical research issue becomes the aggregate change, if any, of the skill level in economies. Studies here have suffered from difficulties in conceptualizing skill independent of education levels, and in measurement across job sectors and across time. More support comes from specific studies. In the U.S., the growth of schooling has far exceeded the technologically induced demand for increased skills in the economy. In the distribution of wages as returns to education of individuals, gender gaps through occupational sector segregation (England, 1992; Baron and Burton, 1992) and religious/racial/ethnic gaps through residential and school segregation were found (Meyer, Tyack, Nagel and Gordon, 1979; Ralph and Robinson, 1980; McNabb and Psacharopoulos, 1981; Kirshenman and Neckerman, 1991). Robinson and Ralph (1984) were able to use a direct measure of technical efficiency instead of relying on rough measures of industrialization and urbanization to examine if there is more support for technical-efficiency or allocation theories. In this important study, the conclusion, based on analyzing primary and secondary school enrollments from 1890 to 1970 in the U.S., is that school expansion results from a complex relationship between processes of status competition and technical change.

1.3 Institutional

Institutional theory asks why the modern education system is taken-for-granted as a central and effective organization for socialization and stratification. Education is an institution, or a set of ideological beliefs and organizational structures, which is based not in the alterations of the economy or stratification structure but in the development of the nation-state and citizenship. The nation-state and citizenship patterns are global processes built around a capitalist world economy and Western traditions of rationality and individualism. In the struggle for economic and political power, elites created the nation-state and used a national compulsory education system to establish legitimacy. Correspondingly, new citizens principled on meritocracy are created (Meyer, 1992; Boli, 1989, Fuller, 1991). This symbolic institution has spread globally, in the globalization of values of progress and equality and in the structural isomorphism of modern education systems.

Economic growth through education results from the aggregate level. There are increasing legitimization of categories of economic activity (e.g. the child rearing and agricultural practices of women) and legitimization of the mass of the population as competent economic actors (Meyer, 1992; Benavot, 1989). These processes are instrumental, independent of any individual-level effects such as labor force participation (Meyer et. al., 1991; Benavot et. al., 1991). Feedback mechanisms in the ideal education system which maximizes economic growth, are also limited by other worldwide pressures (Meyer et. al., 1991; Wallerstein, 1987; Portes, 1976). For instance, world system theories emphasize the western-educated elite of less developed countries, who often do not take into account the national economic structural needs in policy-making but instead seek to maximize returns to foreign investments and foreign aid. Less developed countries, more than developed countries, tend to provide the masses with an idea of meritocratic advancement that is less likely to be present.

Like allocation theories, empirical support for institutional theory has relied on finding a pattern of enrollment effects on economic growth that are not mediated by labor force characteristics (Rubinson and Browne, 1994:594). That is, on the differences in returns to education which are left unexplained by human capital theory and on the absence of effects posited by human capital theory. A more direct measure of institutional pressures is needed. This research tradition however, has spanned two decades, and has already amassed a sizeable amount of data and measures. Before embarking on the task of constructing new measures, a review of findings is needed.

2. Research Findings

Specific studies have been based on the effects of scientific and technical education on economic growth (Rubinson and Ralph, 1984; Drori, 1989; Ramirez and Lee, 1990; Benavot, 1992; Meyer and Ramirez, work in progress). These studies tend to juxtapose the relative contributions of technical-functional, allocation and institutional theories, whereas I argue that conditional variation found may not have been based on any intrinsic causal mechanisms of these theories, but on the cross-sectoral and temporal variation in the requisites of the economy for different sectors and at different stages of development. In this regard, one needs to look at the nature of scientization in societies. Scientization is a demystifying process whereby the discovery of general, physical laws and regularly working systems is assumed possible (Frank, 1995; Schofer, 1996). The human scientization, together with the scientization of physical objects (that is, the utilization of technology), are taken-for-granted as an integral part of modern societal

advancement. Throughout the major part of the historical process of nation-building, the more scientifically and technologically advanced nations are also the more economically prosperous. It follows that, to take into account limited resources and cross-sectoral variation in human faculties, an emphasis on general math and science education for the masses, and elite education for the few and talented, would seem most functional for most modern economies. For example, such a policy was most explicitly practiced in class-structured Germany from 1850 to 1928 (Rubinson and Fuller, 1991:112).

Secondly, there are effects of temporal variation. This shifts the economic requisites for development for national economies. There may be cyclical phrases alternating between scientization of the human (e.g. mass scientization of the 1960s-1970s privileging reallocation mechanisms, such as the institutionalization of women's movement, affirmative action, welfare programs, marriage and divorce laws in the U.S.) and the physical (elite scientization of the 1970s-80s privileging property laws - ISO, patents, environment and the like). Distinctions of mass and elite scientization, and within these, physical and human oriented scientization, are heuristically useful typologies. Corresponding, empirical evidence often shows that there is relative preeminence of the public bureaucracy and the economic institution at different time periods, and these may be associated with broad economic cycles in the global economy.

Such a view of economic prerequisites is in line with Benavot 's (1992) finding that the positive effects of different levels of schooling on economic development vary according to changes in the global economy. In his study, Benavot (1992) includes countries at all levels of development and covers several periods from 1913 to 1985. His findings are:

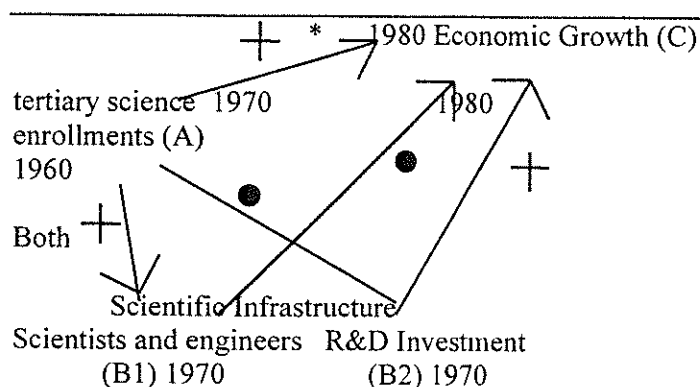
- 1) primary school enrollments had the strongest and most consistent effects on economic growth,
- 2) secondary education contributed to economic growth only during long periods of economic growth,
- 3) higher education had negative or no effects on economic growth.

To Benavot (1992), primary education effects are widespread legitimation effects, and negative higher education effects are elite legitimation effects. The latter is growth-retarding and consumption-oriented. In an earlier study, Ramirez and Lee (1989) used a multivariate cross-national panel analysis to study the effects of science and technical education and investment on economic growth. Unlike Benavot (1992), they found that in tertiary education, science and engineering student enrollments increased the rate of economic growth, especially in less developed countries (LDCs). But again, there is lack of labor force participation mediation

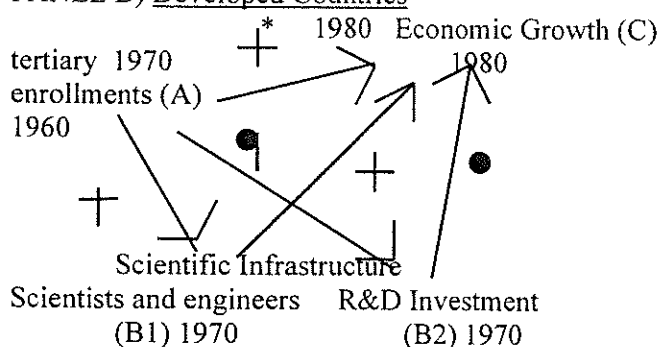
effects, measured by the number of scientists and engineers in the labor force. There was however, a noted positive effect of research and development investment. Ramirez and Lee (1989) see the direct enrollment effect as supporting institutional theory, which argues that such education legitimates further economic activity, or signal a country's well-being as to attract more foreign aid and investments from more developed countries (although this was not tested).

FIGURE A - Proposed Path Diagrams

PANEL A) Less Developed Countries



PANEL B) Developed Countries



To provide a clearer picture, I summarize the multiplicity of findings with Figure A. Figure A is hewn from some general findings of Ramirez and Lee (1989), Benavot (1992) and Meyer and Ramirez (work in progress). Panel A shows the effects for tertiary science enrollment and scientific infrastructure (measured as the number of scientists and engineers in economy, and

R&D investment) on economic growth in the less developed countries, using data from 1960 to 1980. Panel B shows the same for the group of 22 developed countries. From these two panels, a systematic understanding of the conditional variation of human capital, allocation and institutional theoretical measures can be arrived at:

(A) From 1960-1980, tertiary science enrollment promotes economic development for less developed countries more than developed countries, suggesting that less developed countries are more susceptible to the institutional processes of expanding and legitimating economic activities (see Tables 1 & 2 in Ramirez and Lee).

(B) From 1960 to 1970, a period of expansionary global economy for all countries, tertiary science enrollment favors the building of a scientific infrastructure measured as scientific labor force participation rather than R & D investment (see Tables 5A and 5B in Ramirez and Lee).

(C) A decade later (1970-1980 models), characterized by a contractionary global economy, the effect of scientific infrastructure for economic growth in less developed and developed nations diverge significantly:

i) In less developed countries, scientific labor force participation failed to lead to economic growth, thereby refuting human capital theory. Instead, these countries relied on R & D investments, unaffected by tertiary science enrollment a decade ago, to stimulate economic growth. But note that Benavot (1992) and Ramirez and Lee (1989) have found that secondary science education promoted R & D investment and not scientific labor force participation in the previous global economic growth period. Hence, mass scientization, followed by physical favors economic growth. Such sectoral distinctions suggest that allocation processes are at work. The temporal discontinuity between education enrollments and labor market participation reflects loose coupling which has no impact on economic growth.

ii) On the other hand, in developed nations there are direct and indirect positive effects (through increased scientific labor force participation) of tertiary science enrollment on economic growth. At the tertiary education level, both institutional and human capital processes are at work over allocation processes (to the extent that the increased number of scientists and engineers were productive and efficient enough to affect economic growth favorably).

Extant research findings on the effects of education on national economic development can be systematically reconceptualized and reanalyzed to reveal a clearer picture of the causal mechanisms and contextual mediation of human capital, allocative and institutional processes. More sophisticated structural equation models which accommodate (1) the examination of direct and indirect effects between education, labor force participation, returns to capital to economic

development, (2) reciprocal effects, (3) more than two time points, and (4) generalized estimation, will be helpful.

In the next section, I attempt a preliminary analysis of the relation of education and economic growth for the case of Singapore. To date, studies (Low et. al.; Teo, 1988; Pang, 1976) have focused on the private and social rates of returns to education, and not on the macro-level variables in the relation between education and economic growth.

3. The Case of Singapore

3.1 Historical Evolution

The historical evolution and development of Singapore's education system can be divided into four sub-periods: The British colonial period, from 1959 to 1968, from 1969 to 1978 and finally from 1979 onwards (Low et. al., 1991). In the colonial period, Singapore primarily served British interests as a colonial trading outpost. "The British had ensured that the basic infrastructure necessary for economic transactions to take place, such as law, security and other social facilities, was in place. Beyond that, the development of human resources as with other aspects of economic development was not their main concern. After the Second World War, the Ten-Year Programme laid down the educational policy based on the following guideline (Soon, 1988):

"First, that education should aim at fostering and extending the capacity for self-government, and the ideal of civic loyalty and responsibility; second, that equal educational opportunity should be afforded to the children – both boys and girls – of all races; third, that upon a basis of free primary education there should be developed such secondary, vocational and higher education as will best meet the needs of the country."

In the post-colonial period (1959-1968), what is worthy of mention in this period of transition from self independence in 1959 to full independence in 1965, is the shift in the exploitation of education for political and ethnic primordial interests to the economics of education. There is a notable switch in emphasising the link between education and economic growth. The major concern of public policy during the 1960s was to accelerate economic growth and the rate of job creation so as to reduce the twin problems of mounting unemployment and stagnating income from the entrepot sector. Since the initiation of the First Development Plan in 1961, the emphasis in development strategy has been on industrialisation, taking into account the relative lack of natural resources. Singapore's growth strategy was formulated along two lines: One, through the development of its human resources recognising that people are Singapore's only productive asset; two, through the more technical methods of accelerating the expansion of

the manufacturing sector in an attempt to restructure and diversify the economy. Human resource development begins with basic education. The manpower needs of an industrial economy also require the support of a literate and technically trained workforce. The colonial education was ill equipped for these tasks. The economic demands and the demands for nation-building through socialisation led to a period of rapid and massive expansion of schools. Primary and secondary education enrollment rose from 315, 900 in 1959 to a peak of 522, 611 in 1968. Technical and vocational education, upgrading into polytechnics and tertiary institutions and the expansion of universities, were in line with developmental goals in the manufacturing and service sectors. The year 1968 saw the switch toward more export-oriented industrialisation and manufacturing. The Technical Education department was formed in the Ministry of Education.

The period 1969 to 1979 was a period of consolidation for industrial and educational policies in Singapore. Pupils were channeled into academic, technical and vocational schools following their primary education. Technical subjects were introduced on a compulsory basis for the lower secondary schools in an attempt to equip pupils with practical skills. The industrial base was widening into labour-intensive manufacturing activities and this served as an orientation to blue collar jobs. The economic strategy of the 1970s also emphasised the diversification of the economy; upgrading industries and developing Singapore into a regional and international financial centre. During this period the claims on education came not only from economic demands but also from nation-building and developing a Singaporean identity. Bilingualism, proficiency in English, to survive in the business and commercial world and other aspects such as moral education, all lobbied for both the teachers' and pupils' time. While the quantitative aspect of providing school places and facilities were gradually being met, the qualitative aspect began to make its demands too. Teacher training, well designed curricula and textbooks were compromised in the rush to satisfy school places. In 1978, an Education Study Team, directed by the former Prime Minister, Mr. Lee Kuan Yew, was formed to study the malaise in the education system, manifested in the high rates of attrition the country could ill afford.

From 1979 to the present day, a second industrial restructuring was effected to push the economy into higher value-added, high technology and capital-intensive activities. By 1988, a concerted effort to develop local entrepreneurship was also mounted, with the government assisting local small and medium enterprises through fiscal, financial, marketing and technical aid. Such restructuring had been necessitated by protectionist policies of industrial economies and by domestic constraints such as the shortage of labour. The establishment of new industries such as petrochemicals, biotechnology, aerospace and information technology occurred throughout the 1980s and into the 1990s. Singapore's growth strategy also aims to complement and supplement

the developmental needs of the neighbouring countries because of its comparative advantage in infrastructure and services. Continued emphasis is given to the extension of research and development (R & D) support services, which promote interaction among tertiary institutions; namely the National University of Singapore and the Nanyang Technological Institute, government agencies and multinational corporations. Other high-technology, research-oriented institutions established by the government include the Institute of System Science and the National Computer Board. The Science Park was designed to be the hub of R & D and high technology in Singapore. The Software Technology Centre and Institute of Molecular and Cell Biology also became operational.

Reflecting the pattern of economic development and growth strategies pursued, the educational scene also emphasised quality rather than the fulfillment of mere quantitative demands. These can be seen in the rise of the School Councils, independent schools and the pursuit of creative and thinking schools through the IT Masterplan of 1997.

To summarize, in the pursuit of economic development, the Singapore government has been increasingly channeling much resources into the education system throughout the years. The following table, Table A, shows the total educational expenditure and educational expenditure as a percentage of Gross Domestic Product (GDP) at factor cost figures from 1960 to 1987. In addition, Table B shows the available figures of the number of research scientists and engineers (RSE) and gross government expenditures on research and development (GERD). The scientific infrastructure, based on these two indicators, has been gradually built up since 1978.

3.2 Preliminary Analysis

In this section, I conduct preliminary analysis of the relation between education and economic growth in Singapore by comparing the total, primary, secondary and tertiary school enrollments rates with the rates of economic growth (measured as Gross National Product per capita). The time-series data range from 1965 to 1985 and are shown in Table 1. Figure 1 plots the rate of economic growth over time; Figure 2 shows the total enrollment rates over time. We see from comparing Figure 1 with Figure 2 that there is no correspondence between the total enrollment rates and economic growth rates throughout the period 1965 to 1985 in Singapore. In Figure 3, primary school enrollment rate is shown. When compared with Figure 1's economic growth, we see that there seems to be an inverse relation between the two. In Figure 4, secondary school enrollment rate is shown. When compared with Figure 1's economic growth, we see that there is a direct and positive relation between secondary school enrollment and economic growth in Singapore from 1965 to 1985, although there is a drop in the 6th and 15th year (1970 and 1979

respectively). In Figure 5, tertiary enrollment rate is shown. When compared with Figure 1's economic growth, we see that there is a direct and positive relation between tertiary school enrollment and economic growth in Singapore from 1965 to 1985.

In conclusion, although primary school enrollment did not lead to increased economic growth in Singapore, there is indication that secondary and tertiary school enrollments led to increased economic growth. Firstly, this may be because basic education does not drive the economy as the Singapore economy shifted from a labour-intensive to a capital-intensive industrial base quite early after independence. Secondly, the function of primary school education may be to serve as a legitimating and integrative force of nation-building, especially in the early years after independence. In comparison with Benavot's (1992), findings which showed that primary and secondary enrollments have positive effects on economic growth, and tertiary enrollment has a negative effect on economic growth, the findings for Singapore are dissimilar. Hence, aside for the similar finding that secondary education generally favors economic growth, Singapore is an exceptional case. A more accurate picture can only be provided however, only when we take into account multifarious factors that affect economic growth in an ordinary least squares regression model. These factors would include controlling for total annual R & D investment, the scientific labor force (annual total number of scientists and engineers), and other capital and labor inputs to economic growth. Then the relative efficacy of technical-functional, allocation and institutional theories for the Singapore case can be assessed.

TABLE A – GOVERNMENT EXPENDITURE ON EDUCATION, 1960-86/87

YEAR	Total Educational Expenditure \$'000	Educational Expenditure as % of GDP At Factor Cost
1960	61403	3.00
1965	130211	4.28
1970	196111	3.46
1975	391264	3.13
1976	405872	2.99
1977	415823	2.80
1978	459105	2.79
1979	556419	2.94
1980/81	686379	3.07
1981/82	984568	2.60
1982/83	1358429	4.37
1983/84	1611646	4.41
1984/85	1769729	4.34
1985/86	1779081	4.46
1986/87	1747042	4.46

Source: Department of Statistics, Yearbook of Statistics, various years
(reproduced from Teo, 1988).

TABLE B – RESEARCH SCIENTISTS AND ENGINEERS (RSE) AND GROSS EXPENDITURES ON R & D (GERD)

YEAR	RSE (per 10 000 labour force)	GERD (millions) (as percent of GDP)
1994	7086(41.9)	1,175(1.12)
1993	6629(40.5)	998(1.08)
1992	6454(39.8)	949(1.18)
1991	5218(34)	757(1.01)
1990	4329(29)	571.7(0.9)
1987/88	3361(27)	375(0.8)
1984/85	2401(20)	214(0.5)
1981/82	1193(10)	81(0.3)
1978	818(8)	38(0.2)

Source: Annual Report, National Science and Technology Board, various years

TABLE 1: SCHOOL ENROLMENTS AND ECONOMIC GROWTH IN SINGAPORE, 1965-1985

Year	Enrolments				Economic Growth GNP per capita
	Total	Primary	Secondary	Tertiary	
1965	486811	357075	114736	13807	569
1966	511527	364846	132088	13184	620
1967	527859	368654	144448	13005	663
1968	537257	371970	150641	12447	752
1969	531704	366881	147981	2713	972
1970	527668	363518	145740	13683	1192
1971	531793	357936	153525	14269	1412
1972	537278	354748	161371	15318	1632
1973	542442	345284	173109	16925	1852
1974	536045	337816	174177	17802	2099
1975	532956	328401	176224	18501	2346
1976	526602	316265	177992	20594	2580
1977	518122	308342	178186	20734	2890
1978	510416	300398	179811	20377	3260
1979	503293	290859	159733	20464	3770
1980	501887	291722	156491	22633	4480
1981	501052	285179	158187	24393	5240
1982	506946	286780	157262	26960	5980
1983	521420	290800	161936	31145	6620
1984	528502	288623	164928	35943	7470
1985	529462	278060	164168	39913	7420

Source: Yearbook of Statistics, Singapore, various years

Figure 1: Economic Growth

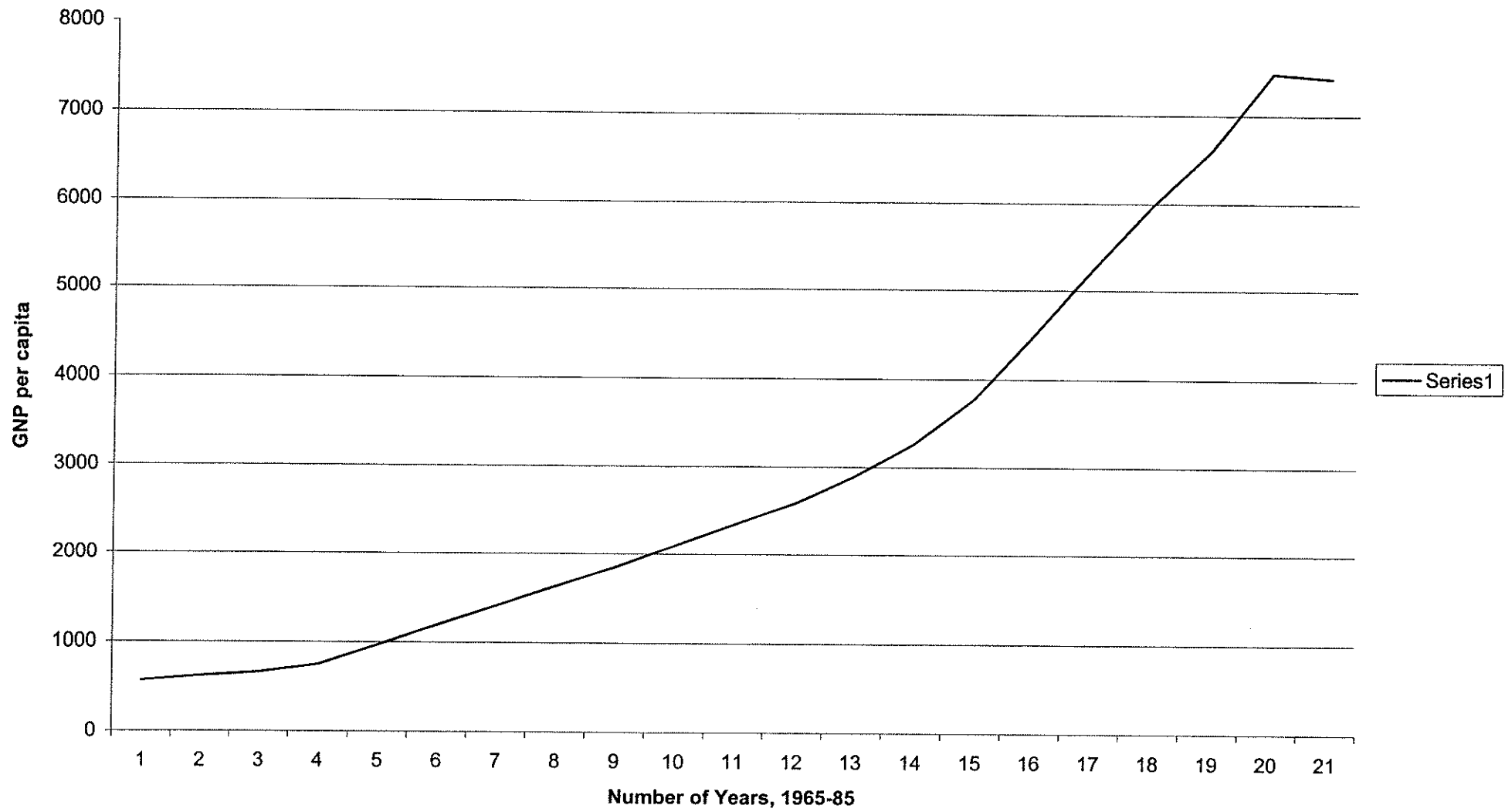


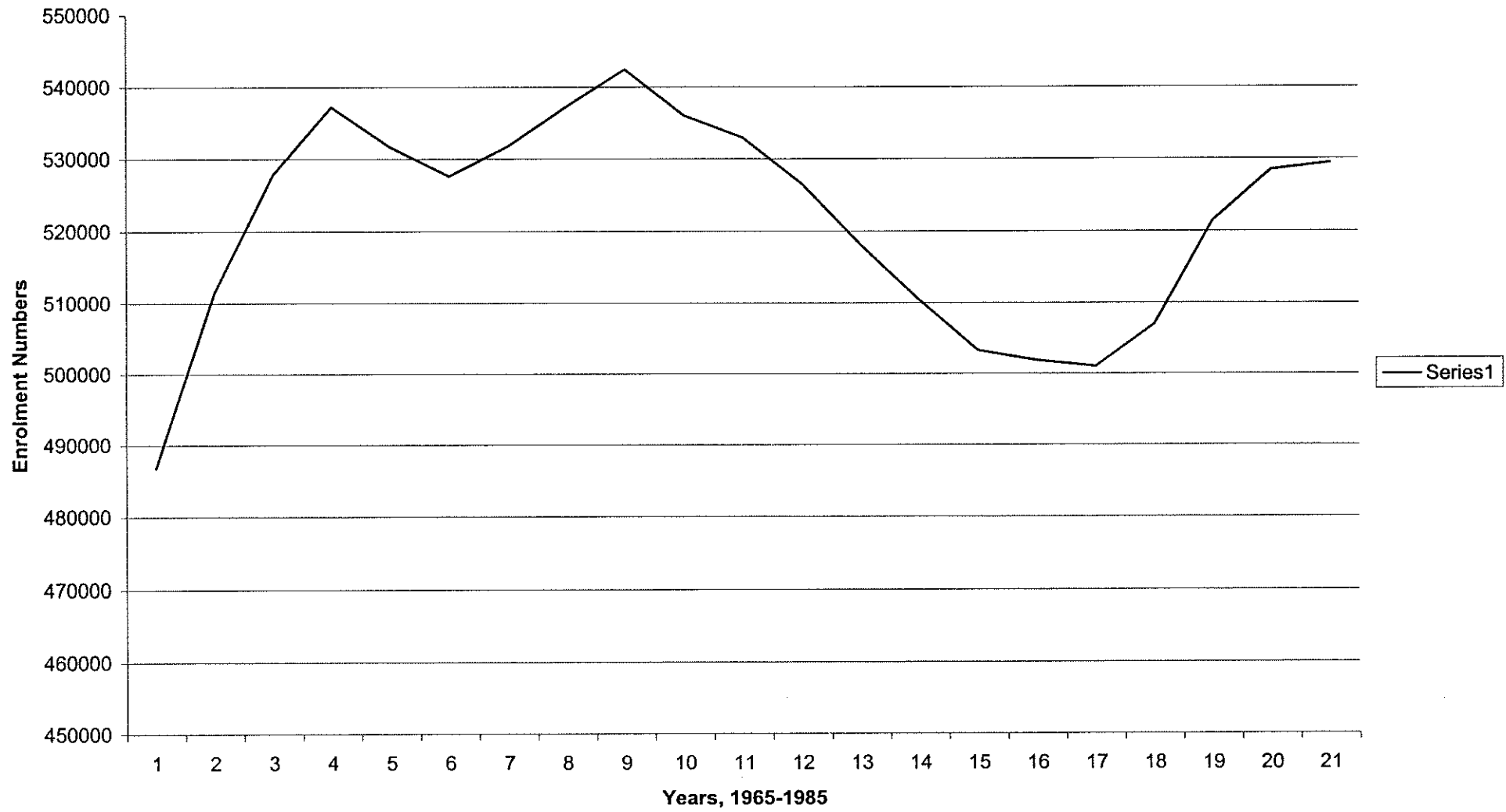
Figure 2: Total Enrolments

Figure 3: Primary Enrolments

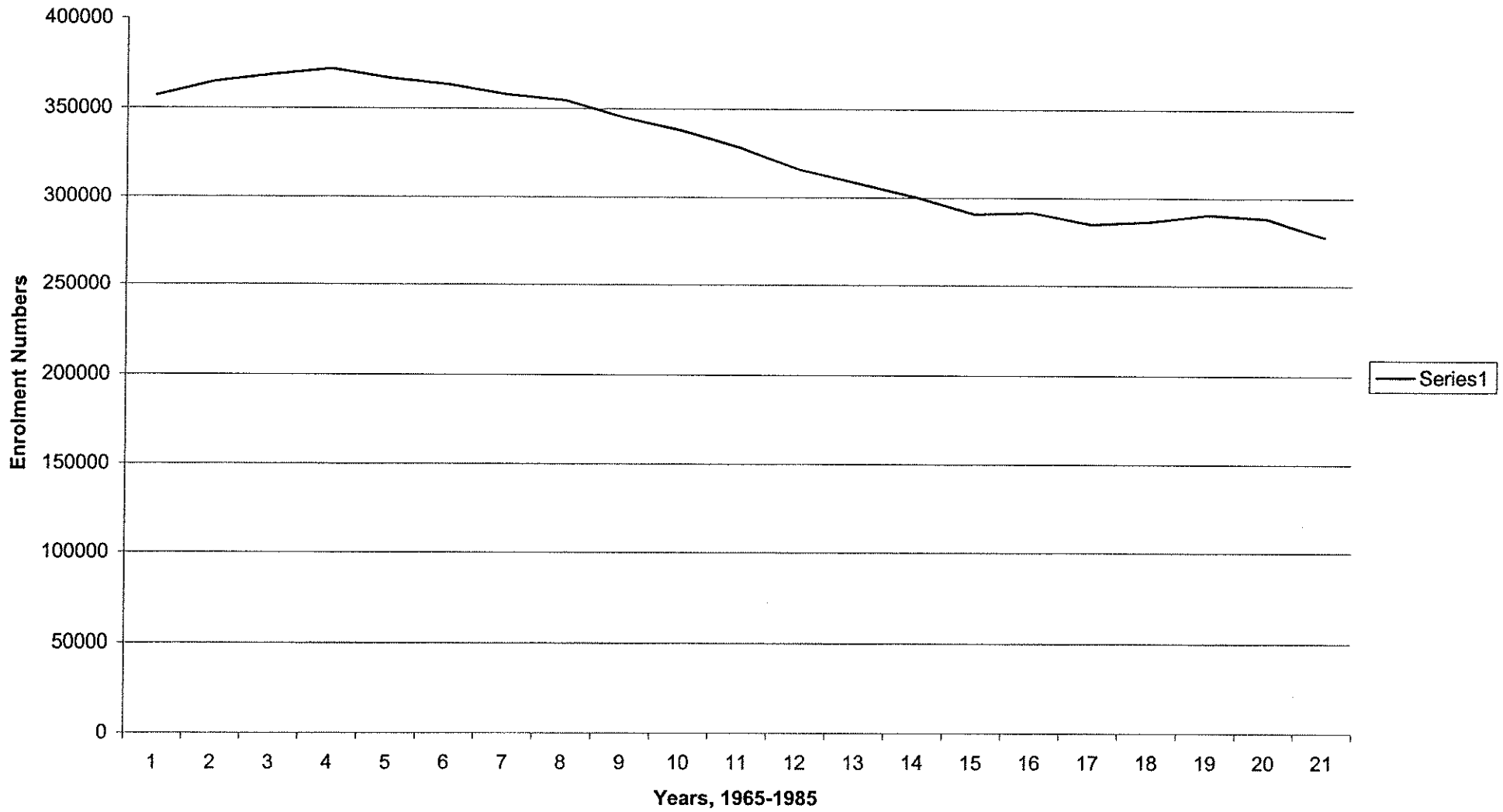


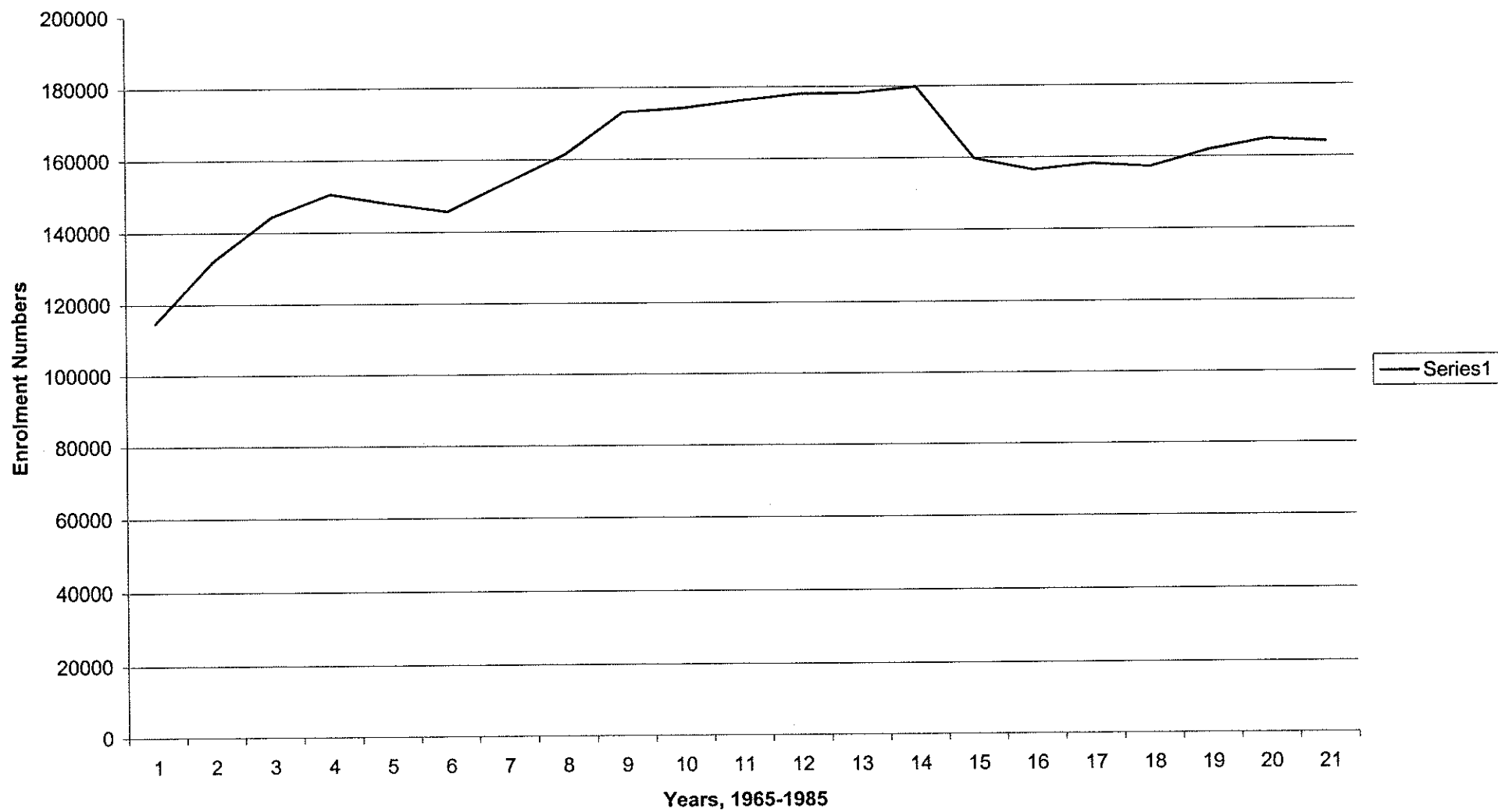
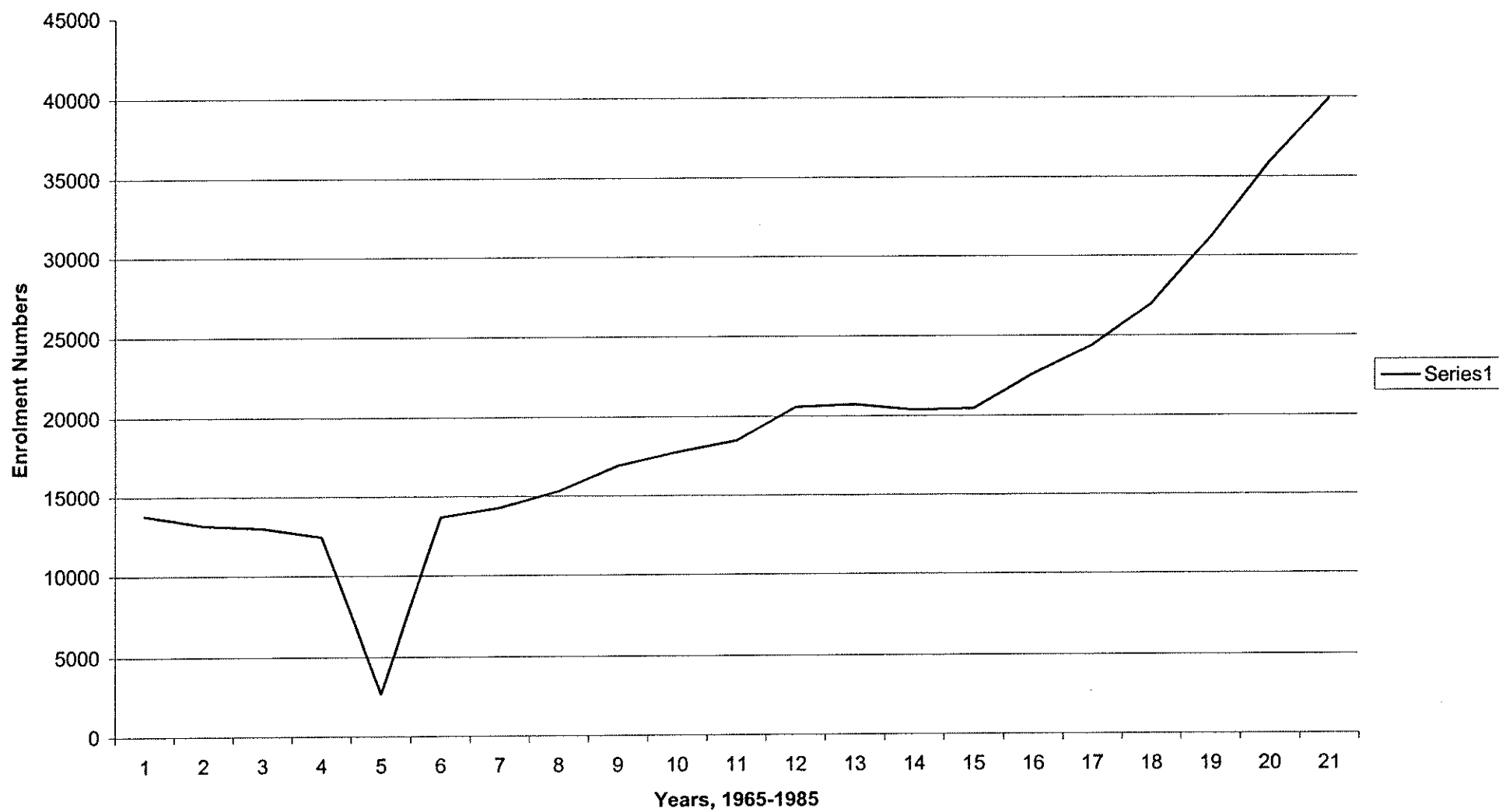
Figure 4: Secondary Enrolments

Figure 5: Tertiary Enrolments



References

- Benavot, Aaron. 1992. "Education Expansion and Economic Growth in the Modern World, 1913-1985." Pp 117-34 in The Political Construction of Education edited by Bruce Fuller and Richard Rubinson. New York: Praeger
- Boli, John. 1992. "Institutions, Citizenship, and Schooling in Sweden." Pp 61-74 in The Political Construction of Education, edited by Bruce Fuller and Richard Rubinson. New York: Praeger
- Bourdieu, Pierre, and Jean-Claude Passeron. 1977. Reproduction in Education, Society And Culture Translated by Richard Nice. London: Sage
- Bowles, Samuel and Herbert Gintis. 1976. Schooling in Capitalist America New York: Basic Books.
- Collins, Randall. 1979. The Credential Society: A Historical Sociology of Education and Stratification New York: Academic Press
- Denison, Edward. 1967. Why Growth Rates Differ: Postwar Experiences in Nine Western Countries Washington, DC: Brookings Institute
- England, Paula. 1992. Comparable Worth: Theories and Evidence New York: Aldine de Gruyter
- Fuller, Bruce. 1991. Growing-Up Modern: The Western State Builds Third World Schools New York: Routledge
- Fuller, Bruce and Richard Rubinson. 1992. "Does the State Expand Schooling? Review of the Evidence." Pp 1-28 in The Political Construction of Education edited by Bruce Fuller and Richard Rubinson. New York: Praeger
- Hannan, Michael. 1979. "Issues in Panel Analysis of National Development: A Methodological Overview" In National Development and the World System edited by Meyer, John and Michael Hannan. Chicago: University of Chicago Press
- Jorgenson, Dale. 1984 "The Contribution of Education to U.S. Economic Growth." Pp 95-162 in Education and Economic Productivity edited by Edwin Dean. Cambridge, MA: Ballinger.
- Kirshenman, Joleen, and Kathryn Neckerman. 1991. "We'd love to Hire Them But ...": The Meaning of Race for Employers." Pp 203-32 in The Urban Underclass, edited by Christopher Jencks and Paul Peterson. Washington, DC: Brookings Institute
- Lareau, Annette. 1990. Home Advantage Philadelphia: Temple University Press
- Low, Linda, Mun Heng Toh and Teck Wong Soon, 1991, Economics of Education and Manpower Development: Issues and Policies in Singapore. Singapore: McGraw-Hill.

- McNabb, Robert and George Psacharopoulos. 1981. "Racial Earnings Differentials in the UK" Oxford Economic Papers 33 (3): 413-25
- Meyer, John and Michael Hannan. 1979. "National Development in a Changing World System: An Overview." In National Development and the World System edited Meyer, John and Michael Hannan. Chicago: University of Chicago Press
- Meyer, John, Francisco Ramirez, Richard Robinson and John Boli. 1977. "The World Education Revolution, 1950-1970." Sociology of Education 50: 247-58
- Meyer, John, David Tyack, Joanne Nagel, and Audri Gordon. 1979. "Public Education as Nation-Building in America: Enrollments and Bureaucratization in the American States, 1870-1930." American Journal of Sociology 85:591-613
- Ramirez, Francisco and Molly Lee. 1990. "Education, Science and Economic Development" Paper presented at U.S. Department of Education Conference on the Comparative Study of Education Systems, Washington, DC.
- Rubinson, Richard. 1986. "Class Formation, Politics and Institutions: Schooling in the United States." American Journal of Sociology 92:519-48
- Rubinson, Richard and Bruce Fuller. 1992. "Specifying the Effects of Education on National Economic Growth" In The Political Construction of Education (edited by Bruce Fuller and Richard Robinson). New York: Praeger
- Rubinson, Richard and John Ralph. 1984. "Technical Change and the Expansion of Schooling in the United States, 1890-1970." Sociology of Education 57
- Rubinson, Richard and Irene Browne. 1992. "Education and the Economy" In The Handbook of Economic Sociology edited by Neil Smelser and Richard Swedberg Princeton: Russell Sage Foundation
- Teo, Eng Hock, 1988 Rates of Return to Education in Singapore Thesis Collection National University of Singapore.

Department of Sociology

Working Papers Series

1. Riaz Hassan and Geoffrey Benjamin, *"Ethnic Outmarriage Rates in Singapore: The Influence of Traditional Socio-Cultural Organisation"*, 1972, 26pp.
2. Hans-Dieter Evers, *"Urban Involution: The Social Structure of Southeast Asian Towns"*, 1972, 19pp.
3. Erik Cohen, *"Social Ecology -- A Multidimensional Approach"*, 1972, 97pp.
4. Noeleen Heyzer and Wee Gek Sim, *"Trade Union Leaders in Singapore"*, 1972, 92pp.
5. Peter S.J. Chen, *"The Political Course of Singapore"*, (in English and Chinese), 1972, 23pp.
6. Chan Heng Chee and Hans-Dieter Evers, *"National Identity and Nation Building in S.E. Asia"*, 1972, 29pp.
7. Peter Weldon, *"Indonesian and Chinese Status Differences in Urban Java"*, 1972, 41pp.
8. Geoffrey Benjamin, *"Austroasiatic Subgroupings and Prehistory in the Malay Peninsula"*, 1972, 63pp.
9. Aline Wong, *"Job Satisfaction among Higher Non-Expatriate Civil Servants in Hong Kong"*, 1972, 64pp.
10. Peter S.J. Chen, *"Modernisation in Singapore: Changing Values and the Individual"*, 1972, 16pp.
11. Geoffrey Benjamin, *"An Outline of Temiar Grammar"*, 1972, 41pp.
12. Peter S.J. Chen, *"Social Stratification in Singapore"*, 1973, 99pp.
13. Peter D. Weldon, John S. Western and Tan Tsu Haung, *"Housing and Satisfaction with Environment in Singapore"*, 1973, 30pp.
14. Mochtar Naim, *"Penghulu di Minangkabau (Penghulu as Traditional Elite in Minangkabau)"*, 1973, 31pp.
15. Michael A.H. Walter, *"A Comparative Examination of Systems of Kinship and Marriage in Fiji"*, 1973, 41pp.
16. Hans Dieter-Evers and Daniel Regan, *"Specialisation and Involvement: The Modernising Role of Doctors in Malaysia and Indonesia"*, 1973, 33pp.
17. Myrna L. Blake, *"Kampong Eurasians in Singapore"*, 1973, 45pp.
18. Mak Lau Fong, *"The Forgotten and the Rejected Community -- A Sociological Study of Chinese Secret Societies in Singapore and West Malaysia"*, 1973, 150pp.
19. Erik Cohen, *"Southeast Asian Urban Sociology -- A Review and a Selected Bibliography"*, 1973, 53pp.
20. Thelma Kay, *"Group Cohesion and Productivity among Dockworkers -- A Study of Stevedores in Singapore"*, 1973, 28pp.
21. Eddie C.Y. Kuo, *"Industrialisation and the Family Type: An Overview"*, 1974, 45pp.
22. Hans-Dieter Evers, *"Changing Patterns of Minangkabau Urban Landownership"*, 1974, 45pp.
23. Peter S.J. Chen, *"Social and Psychological Aspects of Fertility: Findings from Family Planning Research in Singapore"*, 1974, 27pp.
24. Hans-Dieter Evers, *"The Role of Professionals in Social and Political Change"*, 1974, 28pp.
25. Geoffrey Benjamin, *"Prehistory and Ethnology in Southeast Asia: Some New Ideas"*, 1974, 32pp.

26. Mochtar Naim, *"Voluntary Migration in Indonesia"*, 1974, 41pp.
27. Lawrence Babb, *"Walking on Flowers in Singapore -- A Hindu Festival C: in Aram Yengoyan and Alton L. Cycle"*, 1974, 46pp.
28. Geoffrey Benjamin, *"Indigenous Religious Systems of the Malay Peninsula"*, 1974, 27pp.
29. Aline K. Wong, *"Women as a Minority Group in Singapore"*, 1974,
30. Michael A.H.B. Walter, *"Co-operation in East Fiji: A New Traditionalism?"*, 1974, 30pp.
31. Aline K. Wong, *"The Continuous Family Revolution in China -- Ideology and Changing Family Patterns"*, 1974, 28pp.
32. Eddie C.Y. Kuo and Riaz Hassan, *"Some Social Concomitants of Interethnic Marriage in Singapore"*, 1974, 28pp.
33. Riaz Hassan, *"Symptoms and Syndromes of the Developmental Process in Singapore"*, 1974, 11pp.
34. Hans-Dieter Evers and Riaz Hassan, *"Studies on Social Stratification in Southeast Asia"*, 1974, 141pp.
35. Pang Eng Fong and Thelma Kay, *"Change and Continuity in Singapore's Industrial Relations System"*, 1974, 27pp.
36. Eddie C.Y. Kuo, *"Field Theory as a Conceptual Framework for Divorce Study"*, 1974, 25pp.
37. Riaz Hassan, *"International Tourism and Intercultural Communication: The Case of Japanese Tourists in Singapore"*, 1974, 23pp.
38. Riaz Hassan, *"Towards a Dialectic Anthropology -- A Comment on Professor M. Freedman's Paper, Social and Cultural Anthropology"*, 1974, 7pp.
39. Hans-Dieter Evers, *"Urbanisation and Urban Conflict in Southeast Asia"*, 1974, 16pp.
40. Michael A.H.B. Walter, *"The Gardening Game"*, 1975, 15pp.
41. Frederic C. Deyo, *"Organisation and Its Socio-Cultural Setting: A Case Study of Structural Compensation in an Atomistic Society"*, 1975, 31pp.
42. Mak Lau Fong, *"Chinese Secret Societies in Ipoh Town, 1945-1969"*, 1975, 17pp.
43. Vivienne Wee, *"A Preliminary Account of 'Buddhism' in Singapore"*, 1975, 56pp.
44. Geoffrey Benjamin, *"The Cultural Logic of Singapore's 'Multiracialism'"*, 1975, 34pp.
45. Eckehard Kulke, *"Social Class and Primordial Loyalty in Rural India -- An Approach to the Study of Indian Untouchables"*, 1975, 31pp.
46. Peter S.J. Chen, *"Elites and National Development in Singapore"*, 1975, 15pp.
47. Riaz Hassan, *"Social and Psychological Implications of High Population Density"*, 1975, 30pp.
48. Rory Fonseca, *"Planning and Land-use in Singapore"*, 1975, 26pp.
49. Lawrence A. Babb, *"Thaipusam in Singapore: Religious Individualism in a Hierarchical Culture"*, 1976, 19pp.
50. Rory Fonseca, *"Growth, Transition and the Urban Environment: A Reference Frame for Singapore"*, 1976, 19pp.
51. Peter S.J. Chen, *"Asian Values in Modernising Society: A Sociological Perspective"*, 1976, 17pp.
52. Eddie C.Y. Kuo, *"A Sociolinguistic Profile of Singapore"*, 1976, 20pp.
53. Michael A.H.B. Walter, *"On Transitional Society"*, 1976, 20pp.
54. Frederic C. Deyo, *"Marital Status, Job Orientation and Work Commitment among Semi-Skilled Female Workers in Singapore"*, 1976, 20pp.

55. Frederic C. Deyo, *"Decision-Making and Supervisory Authority in Cross-Cultural Perspective: An Exploratory Study of Chinese and Western Management Practices in Singapore"*, 1976, 24pp.
56. John R. Clammer, *"Sociological Approaches to the Study of Language and Literacy in Southeast Asia"*, 1976, 28pp.
57. Peter S.J. Chen, *"Ecological Distribution of Social Pathology in Singapore"*, 1977, 28pp.
58. Aline K. Wong, *"The Value of Children and the Household Economy -- A Review of Current VOC Studies in the Developing World"*, 1977, 24pp.
59. Chiew Seen Kong, *"Educational and Occupational Attainment of Singapore's Chinese Women and Men"*, 1977, 24pp.
60. Peter S.J. Chen, *"Population Policy and Social Science Research on Population in Singapore"*, 1977, 28pp.
61. Michael A.H.B. Walter and Riaz Hassan, *"An Island Community in Singapore: A Characterisation of a Marginal Society"*, 1977, 44pp.
62. Stella R. Quah, *"The Unplanned Dimensions of Health Care in Singapore: Traditional Healers and Self-Medication"*, 1977, 22pp.
63. John R. Clammer, *"Islam and Capitalism in Southeast Asia"*, 1978, 22pp.
64. Robert G. Cooper, *"Second World First: The Study of Films and the Use of Film in Social Studies"*, 1978, 20pp.
65. Peter S.J. Chen, *"Ethnicity and Fertility: The Case of Singapore"*, 1978, 25pp.
66. Rolf E. Vente, *"Urban Planning and High-Density Living. Some Reflections on their Interrelationship"*, 1979, 13pp.
67. William S.W. Lim, *"A Case for Low-Rise High-Density Living in Singapore"*, 1979, 13pp.
68. Mak Lau Fong, *"Subcommunal Participation and Leadership Cohesiveness of the Chinese in 19th Century Singapore"*, 1984, 23pp.
69. Eddie C.Y. Kuo and Huey Tsyh Chen, *"Towards an Information Society: Changing Occupational Structure in Singapore"*, 1985, 29pp.
70. Ko Yiu Chung, *"Industrial Workers and Class Formation: A Study of Chinese Industrial Workers in North China, 1900-1937"*, 1986, 31pp.
71. Geoffrey Benjamin, *"Between Isthmus and Islands: Reflection on Malayan Palaeo-Sociology"*, 1986, 43pp.
72. Habibul H. Khondker, *"Is There a Dependency Paradigm?"*, 1986, 55pp.
73. Mak Lau Fong, *"The Locality and Non-Locality Organising Principles: A Technical Report on the Taxonomy of Chinese Voluntary Associations in the 19th Century Straits Settlements"*, 1986, 33pp.
74. Chua Beng Huat, *"Reading Foucault as a Conservative"*, 1986, 40pp.
75. Vivienne Wee, *"Material Dependence and Symbolic Independence: Constructions of Melayu Ethnicity in Island Riau, Indonesia"*, 1986, 46pp.
76. Habibul Haque Khondker, *"Famine Response: The 1984-85 Ethiopian Famine"*, 1986, 38pp.
77. Allen J. Chun, *"Conceptions of Kinship and Kingship in Classical Chou China"*, 1986, 50pp.
78. V. Selvaratnam, *"Ethnicity, Inequality and Higher Education in Peninsular Malaysia: The Sociological Implications"*, 1987, 44pp.
79. Trevor O Ling, *"Buddhism, Confucianism and the Secular State in Singapore"*, 1987, 42pp.
80. Mak Lau Fong, *"The Social Alignment Patterns of the Chinese in 19th-century Penang"*, 1987, 32pp.
81. Allen J. Chun, *"Durkheim Reconsidered: A Critique of Primitive Structuralism"*,

- 1987, 30pp.
82. Geoffrey Benjamin, *"Process and Structure in Temiar Social Organization"*, 1987, 46pp.
83. Eddie C.Y. Kuo, *"Confucianism and the Chinese Family in Singapore: Continuities and Changes"*, 1987, 32pp.
84. Tatsuko Takizawa, *"Facets of Musical Activities in Singapore"*, 1987, 35pp.
85. Geoffrey Benjamin, *"Notes on the Deep Sociology of Religion"*, 1987, 37pp.
86. Habibul Haque Khondker, *"The World According to Wallerstein"*, 1987, 48pp.
87. Mak Lau Fong, *"Solidarity Models: A Sociological Framework For Comparative Criminal Organization"*, 1988, 29pp.
88. Geoffrey Benjamin, *"Grammar and Polity: The Cultural and Political Background to Standard Malay"*, 1988, 51pp.
89. Viswanathan Selvaratnam, *"Limits to Vocationally-Oriented Education in the Third World"*, 1988, 36pp.
90. Vivienne Wee, *What does 'Chinese' mean?: an exploratory essay*, 1988, 41pp.
91. Geoffrey Benjamin, *The unseen presence: a theory of the nation-state and its mystifications*, 1988, 55pp.
92. Tong Chee Kiong, *Perceptions and boundaries: problematics in the assimilation of the Chinese in Thailand*, 1988, 30pp.
93. Alan J Chun, *Toward a political economy of the sojourning experience: the Chinese in 19th century Malaya*, 1988, 39pp.
94. Chua Beng Huat, *Public housing policies compared: US, Socialist countries and Singapore*, 1988, 41pp.
95. Eddie C. Y. Kuo and Bjorn H. Jernudd, *Language management in a multilingual state: the case of planning in Singapore*, 1988, 45pp.
96. Ho Kong Chong, *The community study: a discussion of the method with modifications for research in Singapore*, 1988, 44pp.
97. Tan Ern Ser, *Employing organizations and the dynamics of social mobility in Singapore: an analytical framework and empirical analysis*, 1988, 43pp.
98. Mak Lau Fong, *Singapore Chinese traditional voluntary associations: convergence vs divergence*, 1989, 36pp.
99. Tong Chee Kiong, *Centripetal authority, differentiated networks: the social organization of Chinese firms in Singapore*, 1989, 36pp.
100. Chan Kwok Bun and Ho Kong Chong (eds), *Explorations in Asian sociology. 100th special issue*, Singapore: Chopmen Publishers 1991, 54pp.
101. Eddie C. Y. Kuo, *Ethnicity, polity and economy: a case study of Mandarin trade and the Chinese connection*, 1990, 36pp.
102. Chua Beng Huat, *Fashion shopping: programs, stages and audience*, 1990, 29pp.
103. Georg Stauth, *Revolution in spiritless times: an essay on the inquiries of Michel Foucault on the Iranian Revolution*, 1991, 54pp.
104. Chua Beng Huat & Eddie C. Y. Kuo, *The making of a new nation: cultural construction and national identity in Singapore*, 1991, 43pp.
105. Alfred Choi, *Policing domestic disturbances: a research review of police response*, 1991, 40pp.
106. Vineeta Sinha, *Some notes on 'temple'-building and image-worship in Indian religion, in historical perspective*, 1991, 50pp.
107. Ho Kong Chong, *Studying the city in the new international division of labour*, 1991, 43pp.
108. Georg Stauth, *Critical theory and pre-Fascist social thought*, 1991, 35pp.
109. Zhang Xin-Xiang, *A methodological critique of Marx's theory of surplus value*, 1991, 37pp.
110. Lee Siew Peng, *Class and noise tolerance: some ruminations*, 1991, 39pp.

111. Paulin Tay Straughan, *Screening for early detection of cervical cancer: the relationship between social integration and preventive health*, 1992, 34pp.
112. Lian Kwen Fee, *Stratification in Maori society in the 19th century*, 1992, 40pp.
113. Eddie C. Y. Kuo, *Confucianism as political discourse in Singapore: the case of an incomplete revitalization movement*, 1992, 29pp.
114. Syed Farid Alatas, *Some problems of indigenization*, 1992, 46pp.
115. Zhang Xin-Xiang, *Crime and control: a neo-rational choice approach*, 1993, 43pp.
116. Tan Ern Ser, *Theorising the dynamics of industrial relations and trade unionism: lessons from the Singapore case*, 1993, 31pp.
117. Roxana Waterson, *What to celebrate in the United Nations Year of Indigenous Peoples?*, 1993, 55pp.
118. Zhang Xin Xiang, *Education as a vehicle for social stratificational change: the case of Singapore*, 1993, 38pp.
119. James V. Jesudason, *Statist democracy and the limits of civil society in Malaysia*, 1993, 40pp.
120. Filomeno V. Aguilar Jr, *Nouns that sail through history: reified categories and their transcendence in Marx's social theory*, 1994, 50pp.
121. Syed Farid Alatas, *Post-colonial state: dual functions in the public sphere*, 1994, 45pp.
122. Chua Beng Huat, *That imagined space: nostalgia for the kampung in Singapore*, 1994, 39pp.
123. Habibul H Khondker, *Globalization theory: a critical appraisal*, 1994, 42pp.
124. Kwok Kian Woon, *Social transformation and the problem of social coherence: Chinese Singaporeans at century's end*, 1994, 39pp.
125. Chua Beng Huat, *Culture, multiracialism and national identity in Singapore*, 1995, 36pp.
126. Nirmala Purushotam, *Disciplining differences: 'race' in Singapore*, 1995, 33pp.
127. Chua Beng Huat and Tan Joo Ean, *Singapore: new configuration of a socially stratified culture*, 1995, 40pp.
128. Paulin Tay Straughan and Tan Ern Ser, *Shiftwork, job satisfaction, and turnover propensity: nurses in a Singapore hospital*, 1996, 26pp.
129. Habibul Haque Khondker, *Competing paradigms and conflicting theories in the studies of the development of Asian NICs*, 1996, 37pp.
130. Geoffrey Benjamin, *Rationalisation and re-enchantment in Malaysia: Temiar religion 1964-1995*, 1996, 52pp.
131. Selina Ching Chan, *Negotiating and tradition: the identity of indigenous inhabitants in Hong Kong*, 1996, 43pp.
132. Geoffrey Benjamin, *Affixes, Austronesian and iconicity in Malay*, 1997, 31 pp.
133. Chua Beng Huat and Ananda Rahah, *Hybridity, Ethnicity and Food in Singapore*, 1997, 24 pp.
134. Kay Mohlman, *Home-base Workplaces and Workplace Domesticities: A Socio-Spatial Analysis*, 1998, 28pp.
135. Paulin Tay Straughan, *The Social Contradictions of the Normal Family: Challenges to the Ideology*, 1999, 18pp.
136. Vineeta Sinha, *Colonial Encounters: Transplanting "Western Medicine"; Ousting "Traditional" Healing?* 1999, 42pp.
137. Tong Chee Kiong and Lian Kwen Fee, *The Nationstate and the Limits to Globalization in Southeast Asia*, 1999, 30pp.
138. Chia Hwee Kim Karen, *Experiencing Sacred Spaces: The Negotiation of Authenticity by Tourists and Worshippers*, 1999, 45pp.
139. Leong Wai Teng, *Consuming the Nation: National Day Parades in Singapore*, 1999, 16pp.

140. Maribeth Erb, *What is a Tourist?: Tourists and Other Spirits in the Manggaraian World*, 1999, 28pp
141. Syed Farid Alatas and Vineeta Sinha, *Teaching Classical Sociological Theory in Singapore: The Context of Eurocentrism*, 1999, 34pp
142. Thomas Menkhoff and Jochen Wirtz, *Local Responses to Globalisation-The Case of Singapore*, 1999, 34pp
143. Johannes Han-Yin Chang, *China: An Unintended Transformation of Class Stratification*, 1999, 32pp
144. Srilata Ravi, "Antivoyages-Reflections on women travellers' writings", 1999, 18pp
145. Goh Pei Siong Daniel, *Space, Meaning and A "Neighborhood" Charismatic Fundamentalist Church*, 1999, 30pp
146. Ng Tang Nah, *The Effects of Science Education on National Economic Growth in The World and Singapore*, 1999, 21pp